



REVIEW OF RESEARCH

ISSN: 2249-894X

IMPACT FACTOR : 5.7631 (UIF)

UGC APPROVED JOURNAL NO. 48514

VOLUME - 8 | ISSUE - 9 | JUNE - 2019



EXPLORING *OPUNTIA ELATIOR* MILL AS A NEW DYE SOURCE FOR WOOL DYEING

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ABSTRACT:

Today in the era of green and safe environment, synthetic dyes cause hazardous effects, where natural dyes can be a safe alternative. The present investigation focused on *Opuntia elatior* Mill extract for dyeing of wool. The scouring of wool was carried out with ritha nuts. Alum and natural mordants Pomegranate rind and Harda were used for mordanting. The dyed samples imparted vivid range of pink colour. Good to excellent wash, rubbing, perspiration and light fastness was observed.



KEYWORDS: *Opuntia elatior*, wool, natural mordants.

INTRODUCTION :

Global environmental and health awareness has turned down the need to revive the traditional vanishing culture of natural dye and dyeing techniques as an alternative to hazardous synthetic dyes (Samanta 2012). Nowadays, a great awareness on the impact of toxic chemicals on the environment and human health has turned down the use of synthetic chemicals and in these circumstances, higher demand is put towards the greener alternative substances in the field of dyeing. In recent days the inherent advantages of vegetable dyes and its awareness has resulted in the revival of demand of the dyes. The sustainable fashion

wants to reopen the natural dyed fabrics in view of its unique qualities. Extension of palette of natural dyes is the need of the day. Cactus is a group of plants with peculiar shape and size and mostly adopted for dessert life. *Opuntia* is very commonly grown cactus, normally occurring on road sides, rocky or sandy places. They are differentiated by their flat jointed stem. Some are quite attractive, having red or yellow bristles. The genus includes over three hundred species (Anonymous 2013). *Opuntia elatior* Mill is a hardy succulent plant of Cactaceae family found in dry and arid area. This plant is also known as prickly pear because of its egg-shaped red coloured fruit. Fruit and fruit peel are phytochemically rich containing betacyanin pigment. According to Ali 2011,

betacyanin pigment of fruit can be a good source of natural colourant.

METHOD:

Source – *Opuntia elatior* Mill fruits were collected in the local area.

Substrate: 100% pure wool was taken for the experiment.

20 % Ritha powder (owf) was used for scouring of wool.

Alum, pomegranate rind and harda were used as natural mordants whereas alum was used as a sole mordant. Pomegranate rind and Harda powder were used as natural mordants in binary combination with alum. The samples were pre mordanted with 10% alum. Pomegranate rind and Harda as a single mordant. Alum in binary combination with (Alum + Harda), (Alum + Pomegranate rind) as natural mordants with

(9:1) (7:3) and (5:5) proportions for each mordant combination.

Fresh fruits of *Opuntiaelator* Mill were collected. Fruit peel and fruit extract was used separately for dye extraction. Separate solutions were prepared for fruit and fruit peel. The temperature of solution was raised initially at 80°C in the separate bath. Immediately the temperature of the bath was brought down to room temperature by adding ice cubes. Bath was set aside for 5 minutes and raised the temperature of the bath at 80°C. Mordanted samples were entered in the dyebath and dyeing was carried out for 20 minutes for wool samples.

RESULTS AND DISCUSSION:

Colour fastness means variation or loss of colour due to external conditions like washing, perspiration, rubbing and light which can affect the colour of the dyed samples. Therefore, the dyed fabrics need to be tested against washing, perspiration, crocking/ rubbing and light fastness. Wool and silk as protein fibers dyed with selected dye sources were subjected for various fastness agencies.

3.1 Washing Fastness of *Opuntiaelator* Fruit Dyed Wool

Mordant	Mordant Concentration	Fastness Properties						
		Change in Colour	Staining on Acetate	Staining on Cotton	Staining on Nylon	Staining on Polyester	Staining on Acrylic	Staining on Wool
Alum	10:0	4	5	4	5	5	5	5
P	10:0	4	5	5	5	5	5	5
A + P	9:1	4	5	5	5	5	5	5
A + P	7:3	4	5	5	5	5	5	5
A + P	5:5	4	5	5	5	5	5	5
H	10:0	4	5	5	5	5	5	5
A+ H	9:1	4	5	4	5	5	5	5
A+ H	7:3	4	5	4	5	5	5	5
A+ H	5:5	4	5	4	5	5	5	5

The wash fastness of 10% alum mordanted samples was noted very good. The samples mordanted with 10% harda and pomegranate rind samples exhibited good wash fastness i.e.4 whereas (Alum + Pomegranate) samples gave moderate i.e. 3 and very poor i.e. 2. Results states that harda as a natural mordant are extremely suitable in dyeing with *Opuntiaelator* fruit extract.

3.2 Washing Fastness of *Opuntiaelator* Fruit Peel Dyed Wool

Mordant	Mordant Concentration	Fastness Properties						
		Change in Colour	Staining on Acetate	Staining on Cotton	Staining on Nylon	Staining on Polyester	Staining on Acrylic	Staining on Wool
Alum	10:0	4	5	5	5	5	5	5
P	10:0	4	5	5	5	5	5	5
A + P	9:1	4	5	5	5	5	5	5
A + P	7:3	4	5	5	5	5	5	5
A + P	5:5	4	5	5	5	5	5	5
H	10:0	4	5	5	5	5	5	5
A+ H	9:1	4	5	5	5	5	5	5
A+ H	7:3	4	5	5	5	5	5	5
A+ H	5:5	4	5	5	5	5	5	5

The colour fastness rating towards washing of wool and silk samples dyed with *Opuntiaelator* fruit peel extract are stated in the above table. Colour fastness ratings are shown towards colour change and staining on adjacent acetate, cotton, nylon, polyester, acrylic and wool fabric. 10% Alum showed good results for colour change rated 4 on grey scale for samples dyed with *Opuntiaelator* fruit peel extract. Absolutely no staining was recorded on adjacent acetate, cotton, nylon, polyester, acrylic and wool fabric exhibiting excellent results against both dyed wool and silk samples rated 5.

3.3 Perspiration Fastness (Acidic and Alkaline) of *Opuntiaelator* Fruit Dyed Wool

Mordant	Mordant Concentration	Fastness Properties					
		Acidic			Alkaline		
		Change in Colour	Staining on Cotton	Staining on Silk	Change in Colour	Staining on Cotton	Staining on Silk
Alum	10:0	4	5	5	5	4	5
P.	10:0	4	5	5	5	5	5
A+P	9:1	3	5	5	4	5	5
A+P	7:3	3	5	5	4	5	5
A+P	5:5	3	5	5	4	5	5
H	10:0	4	5	5	5	5	5
A+H	9:1	4	5	5	5	5	5
A+H	7:3	4	5	5	5	5	5
A+H	5:5	4	5	5	5	5	5

The above table interprets the ratings of wool samples dyed with *Opuntiaelator* fruit extract towards acidic and alkaline perspiration fastness. 10% alum as a single mordant exhibited good fastness towards acidic perspiration. Negligible staining was noticed on the adjacent cotton and silk fabric rated 5. Moderate acidic perspiration fastness was noted in case of (A+P) mordanted samples dyed with *Opuntiaelator* fruit extract. Improved fastness was noted in case of natural mordant harda as a single mordant, (A+H) combination with all proportions also exhibited good acidic perspiration fastness. 10% pomegranate rind exhibited good acidic fastness towards dyed wool samples, whereas decrease in fastness was noted when (A+P) mordant combinations and proportions were used.

Alkaline Perspiration Fastness

In case of dyed samples mordanted with 10% alum exhibits excellent rating towards alkaline perspiration fastness. The results obtained were good i.e. 4 and excellent i.e. 5 for staining on adjacent cotton and silk fabric respectively. (A+P) and (A+H) i.e. alum in combination with pomegranate rind and harda with (9:1) (7:3) and (5:5) proportions showed excellent alkaline perspiration fastness. Absolutely no staining was noticed on adjacent cotton and silk fabric and exhibited excellent rating as 5 for all the (A+P) (A+H) combinations with all its proportions.

3.4 Perspiration Fastness (Acidic and Alkaline) of *Opuntiaelator* Fruit Peel Dyed Wool

Mordant	Mordant Concentration	Fastness Properties					
		Acidic			Alkaline		
		Change in Colour	Staining on Cotton	Staining on Silk	Change in Colour	Staining on Cotton	Staining on Silk
Alum	10:0	4	5	5	4	5	5
P	10:0	4	5	5	4	5	5
A+P	9:1	4	5	5	4	5	5
A+P	7:3	4	5	5	4	5	5
A+P	5:5	4	5	5	4	5	5
H	10:0	4	5	5	4	5	5
A+H	9:1	5	2	5	4	3	5
A+H	7:3	5	2	5	4	3	5
A+H	5:5	5	2	5	4	3	5

Table reveals that the fastness towards acidic and alkaline perspirations was found good in case of dyed wool samples were mordanted with 10%. Alum, rated 4. Absolutely no staining was recorded on adjacent cotton and silk fabric rated 5. 10% pomegranate rind and harda as a single mordant observed good acidic perspiration fastness rated 4. It is evident from the table that samples (A+P) with of (9:1) (7:3) and (5:5) expressed good acidic perspiration fastness i.e. 4 with no staining on adjacent cotton and silk fabric rated 5 on grey scale. The results highlight the excellent performance of natural mordant Harda when used in combination with alum as a binary combination.

3.5 Rubbing Fastness of *Opuntiaelator* Fruit Dyed Wool

Mordant	Mordant Concentration	Fastness to rubbing	
		Dry	Wet
Alum	10:0	5	5
P	10:0	5	5
A + P	9:1	5	5
A + P	7:3	5	5
A + P	5:5	5	5
H	10:0	5	5
A + H	9:1	5	5
A + H	7:3	5	5
A + H	5:5	5	5

3.6 Rubbing Fastness of *Opuntiaelator* Fruit Peel Dyed Wool

Mordant	Mordant Concentration	Fastness to Light	
		Dry	Wet
Alum	10:0	5	5
P	10:0	5	5
A + P	9:1	5	5
A + P	7:3	5	5
A + P	5:5	5	5
H	10:0	5	5
A + H	9:1	5	5
A + H	7:3	5	5
A + H	5:5	5	5

The wool samples dyed with *Opuntiaelator* Mill fruit and fruit peel extract exhibited excellent rating towards dry and wet rubbing.

3.7 Light fastness of *Opuntiaelator* Mill Dyed Wool

Mordant	Mordant Concentration	Mordant	Mordant Concentration
Alum	10:0	3	3
P	10:0	4	3
A + P	9:1	3	3
A + P	7:3	3	3
A + P	5:5	3	3
H	10:0	3	3
A + H	9:1	2	2
A + H	7:3	2	2
A + H	5:5	2	2

Table highlights the degree of light fastness of wool & silk samples dyed with *Opuntiaelator* Mill fruit and fruit peel extract. Moderate light fastness was recorded towards wool samples dyed with *Opuntiaelator* fruit extract. Performance of harda as a natural mordant and harda in binary combination with alum and all proportions found poor when tested against Xenon light.

CONCLUSION:

The present investigation focuses that, fruits of *Opuntiaelator* Mill can be a novel source for dyeing protein fibers. *Opuntiaelator* Mill are grown throughout India and so are easily available. Vivid range shades of pink colour can be obtained using different natural mordants. Fastness properties found to be good to excellent. This dye source is ecofriendly and does not cause problem to its wearer. Thus *Opuntiaelator* Mill can be a good ecofriendly dye for wool as well as silk.

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